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AUTHOR Hymel, Glenn M.; Foss, Lanny
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ABSTRACT

Instructional design issues related to the preparation, implementation, and evaluation of instruction are gaining increased recognition at the tertiary level in health science educational areas such as pharmacy. However, what has been lacking in the available literature on pharmaceutical education is a comprehensive review aimed at characterizing past and current efforts with a view toward formulating a needed agenda for future work where instructional design is concerned. Accordingly, this paper: (1) examines those elements of an instructional unit that provide for the preparation, delivery, and evaluation of instruction; (2) reviews the professional literature available on instructional design themes in pharmaceutical education; and (3) recommends directions that pharmaceutical educators might assume regarding instructional design activities that remain most in need of attention. Three figures and a table present a systems-based model for designing instruction; a systems-based model for designing an instructional unit; a checklist for designing an instructional unit; and citations of instructional design literature, by author and date only, under the headings of Preparing Instruction, Implementing Instruction, and Evaluating Instruction. (Author/DB)

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Instructional Design in Pharmaceutical Education:
A Comprehensive Literature Review

Glenn M. Hymel

Loyola University of New Orleans

Lanny Foss

Xavier University of Louisiana

Running head: INSTRUCTIONAL DESIGN IN PHARMACEUTICAL EDUCATION

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Abstract

Instructional design issues related to the preparation, implementation, and evaluation of instruction are gaining increased recognition at the tertiary level in health science educational areas such as pharmacy. However, what has been lacking in the literature available on pharmaceutical education is a comprehensive review aimed at characterizing past and current efforts with a view toward formulating a needed agenda for future work where instructional design is concerned. Accordingly, this paper (a) examines those elements of an instructional unit that provide for the preparation, delivery, and evaluation of instruction, (b) reviews the professional literature available on instructional design themes in pharmaceutical education, and (c) recommends directions that pharmaceutical educators might assume regarding instructional design activities that remain most in need of attention.

Instructional Design in Pharmaceutical Education:

A Comprehensive Literature Review

In a seminal publication in 1976, Robert Glaser identified the following components of a psychology of instruction as essential to the design of instructional environments: (a) analysis of the competent performance to be achieved, (b) description of the initial state of the learner from which learning proceeds, (c) conditions that can be implemented to bring about a change from the initial state of the learner to the state of competence desired, and (d) assessment of the immediate and long-range effects of instructional implementation.

In a somewhat similar fashion, a comprehensive model of instructional design has been proposed (Hymel, 1984) that accommodates Glaser's four components by focusing on the preparatory, implementation, and evaluative activities or phases of instruction. These three phases of instructional design are further viewed as applying to three levels at which instructional design occurs; viz., the program syllabus, course syllabus, and instructional unit levels.

For purposes of this paper, the principal emphasis is on the three phases of instructional design as applied at the instructional unit level. In that context, then, it must be noted that professional issues related to the preparation, implementation, and evaluation of instruction have gained increased recognition in health science educational areas such as pharmacy. However, what has been lacking in the literature available on pharmaceutical education is a

comprehensive review aimed at characterizing past and current efforts with a view toward formulating a needed agenda for future work where instructional design is concerned.

Accordingly, the balance of this paper (a) examines those elements of an instructional unit that provide for the preparation, delivery, and evaluation of instruction, (b) reviews the professional literature available on instructional design themes in pharmaceutical education, and (c) recommends directions that pharmaceutical educators might assume regarding instructional design activities that remain most in need of attention.

Instructional Design:

Its Essence and Focus at the Unit Level

The process of instructional design involves specifying and producing particular environmental situations in the classroom that incline students to react in such a way that a specified change occurs in their behavior (Merrill, 1971). The relationship between the phases and levels of instructional design is such that the activities of preparing, implementing, and evaluating instruction represent (a) the means to generating instructional products or documents labelled program syllabus, course syllabus, and instructional unit and (b) the tasks that are actually engaged in by the teacher in the attempt to interact with students at three different levels in the instructional process. Figure 1 is a simple illustration of the predominantly deductive movement in the overall process of designing instruction at the program syllabus, course syllabus, and instructional unit levels.

Insert Figure 1 about here

The instructional unit represents the most specific level at which instruction is designed. Accordingly, Figures 2 and 3 represent the systems-based model and checklist for preparing, implementing, and evaluating an instructional unit.

Insert Figure 2 about here

Insert Figure 3 about here

Given the high degree of specificity called for at the instructional unit level, it is perhaps best to consider the components of a unit in the context of the three phases of the design effort.

Phase I: Preparing instruction. The unit description and rationale components are aspects of preparing an instructional unit and should reflect the unit goal specified earlier in the course syllabus. We presume here that the delineation of course goals in the course syllabus reflects in large measure the goals of those units comprising the course.

With respect to the unit rationale, an attempt is made to justify a unit in the course by appealing to (a) its unique value as a dimension of the course, (b) its relationship to previous topics as a continuation of or sequel to that which has already

been covered in the course, and (c) its relationship to future topics as a prerequisite or foundation to material to be addressed.

The performance objectives component is likewise an aspect of preparing instruction at the unit level. It specifies in a detailed fashion the precise behavior (learning) for which the student will be held accountable after instruction, including an indication of the conditions under which the behavior is to be demonstrated and the proficiency level to be attained.

This component should provide a basis for (a) communication between students and instructors as to instructional expectations, (b) planning on the part of instructor and student, and (c) evaluation of student performance and instructor effectiveness.

Furthermore, if the statement of performance objectives is delineated in terms of terminal and enabling objectives, then a mechanism is available for identifying the order in which the various learning tasks are to be measured.

Another component of the unit that relates to the preparation of instruction involves the identification and/or assessment of prerequisite competencies. Since the progression in learning is from the known to the unknown, it is important that a determination be made of the exact prerequisite competencies required of, and supposedly possessed by, the student upon entry into the unit. Otherwise, the appropriate starting point in the presentation of a new topic would not be known by the teacher.

Whether the prerequisite competencies appropriate to a unit are simply identified by the teacher for the benefit of students or actually assessed by the teacher is partially a function of the nature of the material to be covered. The former would probably suffice if the material is not highly sequential and hierarchical; otherwise, both the identification and assessment of prerequisite competencies might be in order.

A final component related to the preparation of instruction involves the delineation and sequencing of the topics comprising the unit with an advance organizer. This is a written aid that students can use to help them relate the potentially meaningful material to be learned to the cognitive base (structure) they already possess.

The advance organizer provides students with a general overview of the more detailed material prior to their actual encounter with it. Although the typical advance organizer is a written narrative that makes use of the student's established knowledge to increase the familiarity and learnability of the new material, other formats such as a topical outline, schematic illustration, flowchart, film, or audiotape may be employed.

Phase II: Implementing instruction. Quite obviously, the instructional methods selected and used by the instructor in a unit as well as the student activities assigned for completion in and out of class are features of implementing instruction. Of particular note here is the necessity for the instructional methods and student activities to reflect the performance objectives of the unit.

The logic of this is based on Gagne's (1985) contention that performance objectives serve as indicators of the type of learning being addressed, which in turn serve as determiners of the most appropriate instructional methods and learning activities. For example, the conditions of teaching and learning that should surround a conceptual learning task are different from the conditions associated with problem solving as a type of learning and, hence, should be recognized and accommodated by the instructor.

Instructional resources represent another facet of implementing instruction. The teacher can select from commercially-prepared resources, instructor-prepared resources, and resource personnel.

In the case of the first two, it is important that instructional design criteria be used in the selection or development process. The components of a systems-based instructional unit that are being addressed would suffice as guidelines for directing the selection/development effort.

With respect to the utilization of resource personnel, one should be sensitive to possible discrepancies between the students' perceptions of credible models or significant others and the actual background of the person used as a resource.

Phase III: Evaluating instruction. As indicated in the model for designing an instructional unit, formative evaluation and learning correctives represent two important components. Although they are crucial sequels to the initial delivery of instruction on unit topics, and perhaps could be justified as aspects of implementing

instruction, they are cited here as components of the evaluation phase which have a pronounced instructional value.

Formative evaluation (variously known in the present context as criterion-referenced trial testing, practice testing, or diagnostic testing) provides on-going, intermittent feedback to the instructor and student concerning the latter's progress at various stages in a given unit of instruction.

This form of criterion-referenced testing occurs several times prior to the completion of the unit and makes possible the identification of learning deficiencies and the subsequent prescription of alternative remedial measures. Formative evaluation, then, provides the "diagnostic" part of any attempt at diagnostic-prescriptive teaching.

As the flowchart indicates, the results of the formative testing suggest the effectiveness/ineffectiveness of the sequencing of topics via the advance organizer, the instructional methods, the student activities, and the resources used at various stages in the unit. In those instances when the formative test results indicate a learning deficiency on the part of a student, learning correctives may be prescribed. These may include alternative ways of sequencing the material, delivering instruction, involving students via assignments, and employing resources. The learning correctives, then, represent the "prescriptive" part of any attempt at diagnostic-prescriptive teaching.

The summative evaluation component in this model refers to a criterion-referenced assessment at the end of the unit to determine

a student's letter grade as based on demonstrated mastery of the unit's prespecified performance objectives.

Finally, the unit evaluation component refers to the students' opportunity to assess the instructional quality of the unit (perhaps via a brief questionnaire) and to the type of achievement distribution attained on the summative test (a negatively skewed curve suggesting instructional success).

Taxonomy of Instructional Design Themes
in Pharmaceutical Education

Table 1 is organized in terms of (a) the three phases/activities of instructional design considered in the context of an instructional unit and (b) four time periods spanning the past two decades. In effect, we have a two-dimensional matrix in which the resulting cell blocks contain literature citations pertinent to the various aspects of instructional design as they appeared across the specified time periods.

Insert Table 1 about here

As conveyed by Table 1, the preponderance of the instructional design focus in pharmaceutical education has been in the areas of instructional methodology and evaluative procedures. The other areas of instructional design emphasis--though not nearly as extreme as the aforementioned--are those of instructional resources and performance objectives.

Recommended Directions in
Instructional Design for Pharmaceutical Educators

Although the literature is most extensive where instructional delivery strategies are concerned, the thrust here is essentially one-dimensional in that there appears to be an overemphasis on instructional methodology per se with little if any regard for possible interactions with learner-oriented variables such as aptitude, learning style, prerequisite background, self-concept, and locus of control.

With regard to the evaluative phase of instruction, there seems to be a healthy balance between the evaluation of student performance and instructor effectiveness. Some areas of need, though, are those of test construction, analysis of test characteristics (e.g., validity, reliability, item discrimination, item difficulty), norm-referenced and criterion-referenced distinctions, and the instructional value of diagnostic formative tests.

Although the coverage of performance objectives as an instructional design feature is present, it is only moderately addressed, and in a one-dimensional fashion at that. The linkage among performance objectives, prerequisite competencies, and the sequencing of content coverage is virtually nonexistent. All three of these preparatory aspects of instructional design--particularly the elements of prerequisites and sequencing content--need considerable expansion in the professional literature.

Finally, although the preparatory features of unit description and rationale might very well seem innocuous, their relationship to the other unit components is crucial and should not continue to be ignored in the literature. Presumably, the narrative description of content coverage would function as a precursor of what follows with respect to performance objectives, prerequisites, and the sequencing of material. With respect to the rationale of a unit, here we are dealing essentially with the factor of motivation--a grossly neglected issue in the available literature that needs immediate attention.

In general, the pharmaceutical education literature over the past 20 years gives evidence of progressive recognition of instructional design themes. This movement has advanced from a very sparse array of relevant articles in the early 1970s to a currently more sophisticated though still too delimited discussion of the issues. We have moved in the right direction at a fairly predictable rate, though not at a pace consistent with what we have learned about the science of teaching.

References

(The extensive list of references is available from the authors upon request.)

Figure 1

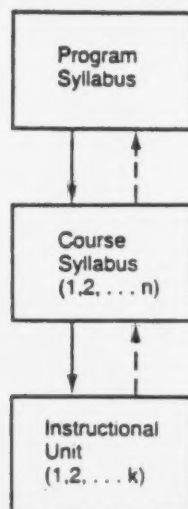
Systems-Based Model for Designing Instruction

Figure 2

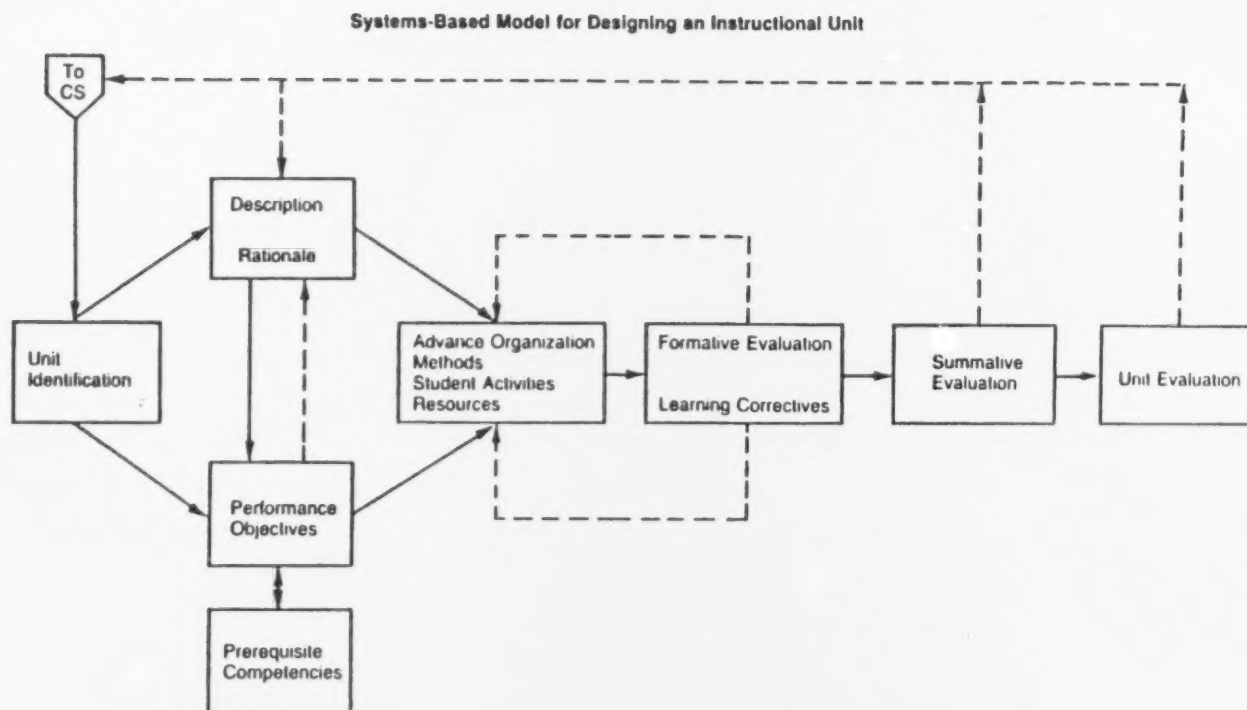


Figure 3

Checklist for Designing an Instructional Unit	Check When Completed
1. Identify the topic addressed in the unit.	_____
2. Describe in narrative form the subject matter content of the unit.	_____
3. State the rationale for the inclusion and location of the unit in the course.	_____
4. List the performance objectives for the unit.	_____
5. Identify and/or construct a test for prerequisite competencies.	_____
6. Outline in detail (via an advance organizer) the various topics and subtopics which comprise the unit.	_____
7. Identify the instructional methods used in the unit.	_____
8. Identify the various learning activities in which the students will engage as they proceed through the unit.	_____
9. Specify the resources utilized in the unit.	_____
10. Construct a formative test that addresses itself to the performance objectives of the unit and that serves a diagnostic purpose.	_____
11. (a) Identify various activities and assignments of a review and/or remedial nature to which a student would be recycled in order to correct certain learning deficiencies uncovered by the formative test.	_____
(b) Prepare a form that reports the results of the formative test and establishes a correspondence between items missed on the formative test and learning correctives.	_____
12. Construct a summative test that addresses itself to the performance objectives of the unit.	_____
13. Construct a unit evaluation form that would be used to facilitate student feedback relative to the effectiveness of the instructional unit.	_____

Table 1

Citations of the Instructional Design Literature in Pharmaceutical Education

Factor A: Time Periods Across 1970-1990

Factor B:

Phases & Components of
Instructional Design
at the Unit Level

	1970-1974	1975-1979	1980-1984	1985-1990
I. Preparing Instruction				
A. Unit Description & Rationale				
B. Performance Objectives	Sauter(73)	Brodie(79);Cobb(76); Day(75);Knapp(77); Lowenthal(78);McLaugh- lin(75);Sice(75); Tindall(75);Veltri et al(76)	Curtiss & Swonger(81) Hanson(81);Miller(84) Purohit & Boker(84)	Burris(88);Carter et al(85);Grussing (87); Hartzema(87) Pancorbo(87)
C. Prerequisites		Scott & Tobias(76)		
D. Sequencing Topics Via Advance Organizer		Fisk et al(75); Scott & Tobias(76)		Gehres et al(89)
II. Implementing Instruction				
A. Instructional Methodology	Crane et al(70): Durgin & Bartilucci (73);Engel et al(74) Hilliard(70);Hodapp & Kauum(70);Lowen- thal(73);Martin(71); Nelson(71)	Anderson & Bickley (76);Anderson et al (77);Blank et al(75); Bogner et al(75); Bond & Angaran(78); Byrd et al(77);Closs- on et al(76);Cobb(76) Foy & Senior(78); Garrett & Williams (76);Goldstein & Mc- Kenzie(75);Hart(75); Hladik et al(79); Kotzan & Wiederholt (79);Leach(76);Len- chek(78);Madsen(77); Manley(78);Mieder- hof(76);Talbert & Walton(76);Tindall (78);Vanselow(75); Volicer(75);Williams & Buatti(78)	Bershon & Sayenga(84) Chase(82);Curtiss(81) Curtiss & Hurd(80); DeMuth et al(83); Gardner & Trinca(82); Hanold et al(82);Han- son & Mergen(83); Hendricson et al(83); Jim et al(84);Krueger et al(80);Kunka & Kunka(82);Mutchie et al(81);Nath et al(81) Riley(84);Pagliaro (81);Pearson & Gilson (83);Pierce(81);Sause & Barcia(81);Sause et al(82);Schwinghammer (81)	Anderson-Harper et al(88);Berger & Felkey(87);Blue (89);DeMuth(87); Feldman et al(89); Gehres et al(89); Hurst et al(88); Kettel(86);Knapp et al(86);Lantz et al(86);McGil- liard(85);McKenzie (85);Miller & Jack- son(85);Myer & Pop- ovich(90);Nahata (86);Sandman & Kelly(85);Shannon (89);Smith et al (89);Strand(87); Talbert et al(87); Vorce-West et al (87); Waigandt et al(86);Walaszek et al(85)
B. Student Activities/ Assignments		Amerson(75);Russi & Wurster(78)	Guy & Piltz(82)	

Table 1 (cont.)

Citations of the Instructional Design Literature in Pharmaceutical Education

Factor A: Time Periods Across 1970-1990

Factor B:
Phases & Components of
Instructional Design
at the Unit Level

	1970-1974	1975-1979	1980-1984	1985-1990
C. Resources	Brettschneider(74); Durgin & Bartilucci (73);Lowenthal(73); Marshall(74);Mrtek & Mrtek(71);Nelson(71) Vogt(70);	Amerson(75);Anderson et al(77);Blank et al (75);Closson et al (76);Dickson & Rodow- skas(75);Fielding & Page(78);Garrett & Williams(76);Idsvoog (78);Rowles(78);Tom- linson(79);	Buerki(82);Guy & Piltz(82);Roffman et al(80);Sause et al (82)	Brass et al(89); Fassett(88); Fassett(89);Hurst et al(88);Kaplan & Andritz(87); McKenzie(85); Shockley(89); Vorce-West et al (87)
III. Evaluating Instruction				
A.-C. Formative Evaluation & Learning Correctives /Summative Evaluation/ Unit Evaluation	Manasee(73);Marshall (74);Mrtek & Mrtek (74);Sauter(73); Smith & Lowenthal (74);Towart et al (74)	Anderson & Bickley (76);Anderson & Wil- son(77);Ayres et al (77);Bennett et al (79);Carlson(75); Cyr(78);Elenbaas(76) Fielding & Page(78); Gandhi(78);Gans(75); Gilson(76);Grussing et al(79);Halloway (79);Henry(75);Hoult (76);Jacoby(76); Jacoby(78);Johnson (78);Kotzan & Entre- Kin(78);Kotzan & Wiederholt(79); Levine(78);Marshall (76);Mckennell & Grussing(79);Parsons & Strom(79);Popovich & Martin(75);Purokit et al(77);Richardson et al(78);Rowles(78); Sauter & Walker(76); Schlegel(78);Smith (75);Solander(78); Sorby(75);Tobias et al(78);Zackert(75); Zanowiak(75);Zanowiak & Husted(76)	Amujahed(82);Baker et al(83);Berchon & Sayenga(84);Curtiss (81);Curtiss & Swon- ger(81);DeMuth et al (83);Fielding et al (81);Garvey et al(84) Guerrant & Swintosky (81);Hanson(81); Henderson(84); Henderson et al(80); Nath et al(81); Pancorbo et al(80); Polinsky & Reid(84); Purokit & Bober(84a) Purokit & Bober(84b) Roffman et al(80); Shannon(81);Smith (83);Sutherland et al(84);Tindall(83)	Aceves-Blumenthal & Stewart(86a); Aceves-Blumenthal & Stewart(86b); Anderson-Harper (88);Blanchard & Aleamoni(85); DeMuth(87); Diamond & Gagnon (85);Downs & Troutman(86); Friend et al(86); Friedman et al (87);Gardner & McGhon(86);Gehres et al(89);Guidry & Cohen(87); Kimberlin(85); Lindley et al(86) Miller & Jackson (85);O'Neil et al (88);Page & Fielding(85);Pray & Popovich(85); Sandman & Kelly (85);Smith et al (89);Speedier(85) Talbert et al(87) Vorce-West et al (87)